

THE ANNALS
of
STATISTICS

AN OFFICIAL JOURNAL OF THE INSTITUTE OF
MATHEMATICAL STATISTICS

VOLUME 4

1976



CONTENTS OF VOLUME 4

ARTICLES AND SHORT COMMUNICATIONS

AGRAWAL, H. L. AND BOOB, B. S. A note on method of construction of affine resolvable balanced incomplete block designs.	954-955
ALAM, KHURSHEED, RIZVI, M. HASEEB AND SOLOMON, HERBERT. Selection of largest multiple correlation coefficients: exact sample size case.	614-620
ALBERS, W., BICKEL, P. J. AND VAN ZWET, W. R. Asymptotic expansions for the power of distribution free tests in the one-sample problem. .	108-156
ALBERT, ARTHUR. When is a sum of squares an analysis of variance? . . .	775-778
ANBAR, DAN. An application of a theorem of Robbins and Siegmund. . .	1018-1021
ANDERSON, T. W. AND TAYLOR, JOHN B. Strong consistency of least squares estimates in normal linear regression.	788-790
ANTILLE, ANDRÉ. Asymptotic linearity of Wilcoxon signed-rank statistics.	175-186
ARNOLD, STEVEN F. Applications of products to the generalized compound symmetry problem.	227-233
ATWOOD, CORWIN L. Convergent design sequences, for sufficiently regular optimality criteria.	1124-1138
AUMANN, ROBERT J. Agreeing to disagree.	1236-1239
BAKSALARY, J. K. AND KALA, R. Extensions of Milliken's estimability criterion.	639-641
BEHNEN, KONRAD. Asymptotic comparison of rank tests for the regression problem when ties are present.	157-174
BERGER, JAMES O. Tail minimaxity in location vector problems and its applications.	33-50
BERGER, JAMES O. Admissible minimax estimation of a multivariate normal mean with arbitrary quadratic loss.	223-226
BERGER, JAMES O. Inadmissibility results for generalized Bayes estimators of coordinates of a location vector.	302-333
BERGER, JAMES O. Admissibility results for generalized Bayes estimators of coordinates of a location vector.	334-356
BERGER, JAMES O. Inadmissibility results for the best invariant estimator of two coordinates of a location vector.	1065-1076
BERGER, JAMES O. AND BOCK, M. E. Combining independent normal mean estimation problems with unknown variances.	642-648
BERK, ROBERT H. Asymptotic efficiencies of sequential tests.	891-911
BHATTACHARYA, P. K. An invariance principle in regression analysis. .	621-624
BICKEL, P. J. AND LEHMANN, E. L. Descriptive statistics for nonparametric models. III. Dispersion.	1139-1158
BICKEL, P. J., VAN ZWET, W. R. AND ALBERS, W. Asymptotic expan-	

sions for the power of distribution free tests in the one-sample problem.	108-156
BIRKES, DAVID, DODGE, YADOLAH AND SEELY, JUSTUS. Spanning sets for estimable contrasts in classification models.	86-107
BIRKES, DAVID, OLSEN, ANTHONY AND SEELY, JUSTUS. Invariant quadratic unbiased estimation for two variance components.	878-890
BLACKWELL, DAVID. The stochastic processes of Borel gambling and dynamic programming.	370-374
BLUMENTHAL, SAUL. Sequential estimation of the largest normal mean when the variance is known.	1077-1087
BOCK, M. E. AND BERGER, JAMES O. Combining independent normal mean estimation problems with unknown variances.	642-648
BONDAR, JAMES V. Borel cross-sections and maximal invariants.	866-877
BONDESSON, LENNART. When are the mean and the Studentized differences independent?	668-672
BOOB, B. S. AND AGRAWAL, H. L. A note on method of construction of affine resolvable balanced incomplete block designs.	954-955
BRAUN, HENRY I. Weak convergence of sequential linear rank statistics	554-575
BROWN, K. G. Asymptotic behavior of MINQUE-type estimators of variance components.	746-754
BROWN, L. D., COHEN, ARTHUR AND STRAWDERMAN, W. E. A complete class theorem for strict monotone likelihood ratio with applications.	712-722
BUEHLER, ROBERT J. Coherent preferences.	1051-1064
CASADY, ROBERT J. AND CRYER, JONATHAN D. Monotone percentile regression.	532-541
CHATTOPADHYAY, A. K., PILLAI, K. C. S. AND LI, HUNG C. Maximization of an integral of a matrix function and asymptotic expansions of distributions of latent roots of two matrices.	796-806
CLINGER, WILLIAM AND VAN NESS, JOHN W. On unequally spaced time points in time series.	736-745
COHEN, ARTHUR, STRAWDERMAN, W. E. AND BROWN, L. D. A complete class theorem for strict monotone likelihood ratio with applications.	712-722
COLLINS, JOHN R. Robust estimation of a location parameter in the presence of asymmetry.	68-85
CRYER, JONATHAN D. AND CASADY, ROBERT J. Monotone percentile regression.	532-541
DEELY, J. J. AND ZIMMER, W. J. Asymptotic optimality of the empirical Bayes procedure.	576-580
DE FINETTI, BRUNO. Discussion of "On rereading R. A. Fisher" by Leonard J. Savage.	485-488
DERIN, HALUK, THOMAS, JOHN B. AND TYAN, SHU-GWEI. Two necessary	

conditions on the representation of bivariate distributions by polynomials.....	216-222
DEVORE, JAY L. A note on the estimation of parameters in a Bernoulli model with dependence.....	990-992
DHARMADHIKARI, S. W. AND JOGDEO, KUMAR. Multivariate unimodality.....	607-613
DODGE, YADOLAH, SEELY, JUSTUS AND BIRKES, DAVID. Spanning sets for estimable contrasts in classification models.....	86-107
DOSHI, BHARAT T. Continuous time control of Markov processes on an arbitrary state space: discounted rewards.....	1219-1235
DRYGAS, HILMAR. Gauss-Markov estimation for multivariate linear models with missing observations.....	779-787
EFRON, B. Discussion of "On rereading R. A. Fisher" by Leonard J. Savage.....	483-484
EFRON, BRADLEY AND MORRIS, CARL. Families of minimax estimators of the mean of a multivariate normal distribution.....	11-21
EFRON, BRADLEY AND MORRIS, CARL. Multivariate empirical Bayes and estimation of covariance matrices.....	22-32
EISENBERG, BENNETT, GHOSH, B. K. AND SIMONS, GORDON. Properties of generalized sequential probability ratio tests.....	237-251
EISENHART, CHURCHILL. Discussion of "On rereading R. A. Fisher" by Leonard J. Savage.....	484
ERICKSON, R. V. AND KOUL, H. L. L_1 rates of convergence for linear rank statistics.....	771-774
FENECH, ALAN PAUL. Asymptotically efficient estimation of location for a symmetric stable law.....	1088-1100
FERGUSON, THOMAS S. Stopping a sum during a success run.....	252-264
FLYNN, JAMES. Conditions for the equivalence of optimality criteria in dynamic programming.....	936-953
FRASER, D. A. S. Discussion of "On rereading R. A. Fisher" by Leonard J. Savage.....	488-489
FUJII, YOSHIO. An upper bound of resolution in symmetrical fractional factorial designs.....	662-667
GHOSH, B. K. AND SEN, P. K. Comparison of some bounds in estimation theory.....	755-765
GHOSH, B. K., SIMONS, GORDON AND EISENBERG, BENNETT. Properties of generalized sequential probability ratio tests.....	237-251
GILLILAND, DENNIS C., HANNAN, JAMES AND HUANG, J. S. Asymptotic solutions to the two state component compound decision problem, Bayes versus diffuse priors on proportions.....	1101-1112
GLESER, LEON JAY AND KUNTE, SUDHAKAR. On asymptotically optimal sequential Bayes interval estimation procedures.....	685-711
GODAMBE, V. P. Discussion of "On rereading R. A. Fisher" by Leonard J. Savage.....	490-492

GOOD, I. J. Discussion of "On rereading R. A. Fisher" by Leonard J. Savage	492-495
GOOD, I. J. On the application of symmetric Dirichlet distributions and their mixtures to contingency tables	1159-1189
HALL, GAINEFORD J., JR. Sequential search with random overlook probabilities	807-816
HANNAN, E. J. The asymptotic distribution of serial covariances	396-399
HANNAN, E. J. The convergence of some recursions	1258-1270
HANNAN, JAMES, HUANG, J. S. AND GILLILAND, DENNIS C. Asymptotic solutions to the two state component compound decision problem, Bayes versus diffuse priors on proportions	1101-1112
HANSON, D. L. AND PLEDGER, GORDON. Consistency in concave regression	1038-1050
HARVILLE, DAVID. Extension of the Gauss-Markov theorem to include the estimation of random effects	384-395
HECKER, H. A characterization of the asymptotic normality of linear combinations of order statistics from the uniform distribution	1244-1246
HIPP, C. AND MICHEL, R. On the Bernstein-v. Mises approximation of posterior distributions	972-980
HOLLANDER, MYLES AND KORWAR, RAMESH M. Empirical Bayes estimation of a distribution function	581-588
HUANG, J. S., GILLILAND, DENNIS C. AND HANNAN, JAMES. Asymptotic solutions to the two state component compound decision problem, Bayes versus diffuse priors on proportions	1101-1112
JIRINA, MILOSLAV. On the asymptotic normality of Kencall's rank correlation statistic	214-215
JOGDEO, KUMAR AND DHARMADHIKARI, S. W. Multivariate unimodality	607-613
JOHN, PETER W. M. Inequalities for semiregular group divisible designs	956-959
JOHN, PETER W. M. Robustness of balanced incomplete block designs	960-962
JOHNSON, RICHARD A. AND MEHROTRA, K. G. Asymptotic sufficiency and asymptotically most powerful tests for the two sample censored situation	589-596
JOSHI, V. M. Confidence intervals for linear functions of the normal parameters	413-418
JOSHI, V. M. On the attainment of the Cramér-Rao lower bound	998-1002
KAGEYAMA, SANPEI. Resolvability of block designs	655-661
KALA, R. AND BAKSALARY, J. K. Extensions of Milliken's estimability criterion	639-641
KEMPTHORNE, O. Discussion of "On rereading R. A. Fisher" by Leonard J. Savage	495-497

KHATRI, C. G., SHAH, K. R. AND RAGHAVARAO, D. Optimality of two and three factor designs.	419-422
KIEFER, J. Admissibility of conditional confidence procedures.	836-865
KIEFER, J. AND STUDDEN, W. J. Optimal designs for large degree polynomial regression.	1113-1123
KORWAR, RAMESH M. AND HOLLANDER, MYLES. Empirical Bayes estimation of a distribution function.	581-588
KOUL, H. L. AND ERICKSON, R. V. L_1 rates of convergence for linear rank statistics.	771-774
KOUL, HIRA LAL AND STAUDTE, R. G., JR. Power bounds for a Smirnov statistic in testing the hypothesis of symmetry.	924-935
KUNTE, SUDHAKAR AND GLESER, LEON JAY. On asymptotically optimal sequential Bayes interval estimation procedures.	685-711
LAI, TZE LEUNG. On confidence sequences.	265-280
LEHMANN, E. L. AND BICKEL, P. J. Descriptive statistics for nonparametric models. III. Dispersion.	1139-1158
LI, HUNG C., CHATTOPADHYAY, A. K. AND PILLAI, K. C. S. Maximization of an integral of a matrix function and asymptotic expansions of distributions of latent roots of two matrices.	796-806
LINDLEY, D. V. A class of utility functions.	1-10
LORDEN, GARY. 2-SPRT's and the modified Kiefer-Weiss problem of minimizing an expected sample size.	281-291
MARGOLIN, BARRY H. AND MAURER, WILLI. The multivariate inclusion-exclusion formula and order statistics from dependent variates.	1190-1199
MARONNA, RICARDO ANTONIO. Robust M -estimators of multivariate location and scatter.	51-67
MAURER, WILLI AND MARGOLIN, BARRY H. The multivariate inclusion-exclusion formula and order statistics from dependent variates.	1190-1199
MEEDEN, GLEN. A special property of linear estimates of the normal mean.	649-650
MEHROTRA, K. G. Asymptotic sufficiency and asymptotically most powerful tests for the two sample censored situation.	589-596
MICHEL, R. AND HIPPI, C. On the Bernstein—v. Mises approximation of posterior distributions.	972-980
MORRIS, CARL AND EFRON, BRADLEY. Families of minimax estimators of the mean of a multivariate normal distribution.	11-21
MORRIS, CARL AND EFRON, BRADLEY. Multivariate empirical Bayes and estimation of covariance matrices.	22-32
O'BRYAN, THOMAS E. Some empirical Bayes results in the case of component problems with varying sample sizes for discrete exponential families.	1290-1293

OLSEN, ANTHONY, SEELY, JUSTUS AND BIRKES, DAVID. Invariant quadratic unbiased estimation for two variance components.	878-890
O'REILLY, FEDERICO J. On a criterion for simultaneous extrapolation in nonfull rank normal regression.	625-628
PATHAK, P. K. Unbiased estimation in fixed cost sequential sampling schemes.	1012-1017
PESOTAN, H., SRIVASTAVA, J. N. AND RAKTOE, B. L. On invariance and randomization in fractional replication.	423-430
PILLAI, K. C. S., LI, HUNG C. AND CHATTOPADHYAY, A. K. Maximization of an integral of a matrix function and asymptotic expansions of distributions of latent roots of two matrices.	796-806
PLEDGER, GORDON. Consistency in integral regression estimation with a triangular array of observation points.	234-236
PLEDGER, GORDON AND HANSON, D. L. Consistency in concave regression.	1038-1050
PRÁŠKOVÁ-VÍZKOVÁ, ZUZANA. Asymptotic expansion and a local limit theorem for a function of the Kendall rank correlation coefficient.	597-606
PRATT, JOHN W. F. Y. Edgeworth and R. A. Fisher on the efficiency of maximum likelihood estimation.	501-514
RAGHAVARAO, D., KHATRI, C. G. AND SHAH, K. R. Optimality of two and three factor designs.	419-422
RAKTOE, B. L., PESOTAN, H. AND SRIVASTAVA, J. N. On invariance and randomization in fractional replication.	423-430
RAO, C. RADHAKRISHNA. Characterization of prior distributions and solution to a compound decision problem.	823-835
RAO, C. RADHAKRISHNA. Estimation of parameters in a linear model. ...	1023-1037
RIZVI, M. HASEEB, SOLOMON, HERBERT AND ALAM, KHURSHEED. Selection of largest multiple correlation coefficients: exact sample size case.	614-620
ROBINSON, G. K. Properties of Student's t and of the Behrens-Fisher solution to the two means problem.	963-971
RÜSCHENDORF, LUDGER. Hypotheses generating groups for testing multivariate symmetry.	791-795
RÜSCHENDORF, LUDGER. Asymptotic distributions of multivariate rank order statistics.	912-923
SÄRNDAL, CARL ERIK. On uniformly minimum variance estimation in finite populations.	993-997
SAVAGE, LEONARD J. On rereading R. A. Fisher. Discussion by B. Efron, C. Eisenhart, B. de Finetti, D. A. S. Fraser, V. P. Godambe, I. J. Good, O. Kempthorne and Stephen Stigler.	441-500
SAXENA, K. M. LAL. Distribution-free tolerance intervals for stochastically ordered distributions.	1210-1218
SEELY, JUSTUS, BIRKES, DAVID AND DODGE, YADOLAH. Spanning sets for estimable contrasts in classification models.	86-107

SEELY, JUSTUS, BIRKES, DAVID AND OLSEN, ANTHONY. Invariant quadratic unbiased estimation for two variance components.	878-890
SEN, PRANAB KUMAR. Weak convergence of progressively censored likelihood ratio statistics and its role in asymptotic theory of life testing.	1247-1257
SEN, P. K. AND GHOSH, B. K. Comparison of some bounds in estimation theory.	755-765
SHAH, K. R., RAGHAVARAO, D. AND KHATRI, C. G. Optimality of two and three factor designs.	419-422
SHAMAN, PAUL. Approximations for stationary covariance matrices and their inverses with application to ARMA models.	292-301
SHIRAHATA, SHINGO. On the asymptotic normality of rank statistics for the two-sample problem.	400-405
SHIRAHATA, SHINGO. Tests for independence in infinite contingency tables.	542-553
SHIRAKURA, TERUHIRO. Optimal balanced fractional 2^m factorial designs of resolution VII, $6 \leq m \leq 8$	515-531
SHIRAKURA, TERUHIRO. Balanced fractional 2^m factorial designs of even resolution obtained from balanced arrays of strength 2/ with index $\mu_1 = 0$	723-735
SHORROCK, R. W. AND ZIDEK, J. V. An improved estimator of the generalized variance.	629-638
SIEGMUND, D. Importance sampling in the Monte Carlo study of sequential tests.	673-684
SIEVERS, GERALD L. Probabilities of large deviations for empirical measures.	766-770
SIMAR, LÉOPOLD. Maximum likelihood estimation of a compound Poisson process.	1200-1209
SIMONS, GORDON. An improved statement of optimality for sequential probability ratio tests.	1240-1243
SIMONS, GORDON, EISENBERG, BENNETT AND GHOSH, B. K. Properties of generalized sequential probability ratio tests.	237-251
SINGH, JAGBIR. A note on paired comparison rankings.	651-654
SINGH, R. S. Empirical Bayes estimation with convergence rates in non-continuous Lebesgue exponential families.	431-439
SKIBINSKY, MORRIS. Sharp upper bounds for probability on an interval when the first three moments are known.	187-213
SOLOMON, HERBERT, ALAM, KHURSHED AND RIZVI, M. HASEEB. Selection of largest multiple correlation coefficients: exact sample size case.	614-620
SPRUILL, M. C. Cell selection in the Chernoff-Lehmann chi-square statistic.	375-383
SPRUILL, M. C. A comparison of chi-square goodness-of-fit tests based on approximate Bahadur slope.	409-412

SRIVASTAVA, J. N., RAKTOE, B. L. AND PESOTAN, H. On invariance and randomization in fractional replication.....	423-430
STAUDTE, R. G., JR. AND KOUL, HIRA LAL. Power bounds for a Smirnov statistic in testing the hypothesis of symmetry.....	924-935
STEPHENS, M. A. Asymptotic results for goodness-of-fit statistics with unknown parameters.....	357-369
STIGLER, STEPHEN. Discussion of "On rereading R. A. Fisher" by Leonard J. Savage.....	498-500
STRAWDERMAN, W. E., BROWN, L. D. AND COHEN, ARTHUR. A complete class theorem for strict monotone likelihood ratio with applications.....	712-722
STUDDEN, W. J. AND KIEFER, J. Optimal designs for large degree polynomial regression.....	1113-1123
STUDDEN, WILLIAM J. AND TSAY, JIA-YEONG. Remez's procedure for finding optimal designs.....	1271-1279
TAYLOR, JOHN B. AND ANDERSON, T. W. Strong consistency of least squares estimates in normal linear regression.....	788-790
THOMAS, JOHN B., TYAN, SHU-GWEI AND DERIN, HALUK. Two necessary conditions on the representation of bivariate distributions by polynomials.....	216-222
TSAY, JIA-YEONG AND STUDDEN, WILLIAM J. Remez's procedure for finding optimal designs.....	1271-12.9
TYAN, SHU-GWEI, DERIN, HALUK AND THOMAS, JOHN B. Two necessary conditions on the representation of bivariate distributions by polynomials.....	216-222
VAN NESS, JOHN W. AND CLINGER, WILLIAM. On unequally spaced time points in time series.....	736-745
VAN HOUWELINGEN, J. C. Monotone empirical Bayes tests for the continuous one-parameter exponential family.....	981-989
VAN ZUYLEN, M. C. A. Some properties of the empirical distribution function in the non-i.i.d. case.....	406-408
VAN ZWET, W. R., ALBERS, W. AND BICKEL, P. J. Asymptotic expansions for the power of distribution free tests in the one-sample theorem.....	108-156
WHITT, WARD. Bivariate distributions with given marginals.....	1280-1289
WIEAND, HARRY S. A condition under which the Pitman and Bahadur approaches to efficiency coincide.....	1003-1011
ZIDEK, J. V. AND SHORROCK, R. W. An improved estimator of the generalized variance.....	629-638
ZIMMER, W. J. AND DEELY, J. J. Asymptotic optimality of the empirical Bayes procedure.....	576-580

BOOK REVIEW

HABERMAN, SHELBY J. Review of <i>Discrete Multivariate Analysis: Theory and Practice</i> , by Y. M. M. Bishop, S. E. Fienberg and P. W. Holland	817-820
---	---------

CORRECTION NOTES

COHEN, ARTHUR AND SACKROWITZ, HAROLD B. Correction to "On estimating the common mean of two normal distributions"	1294
Correction to "Contents of Volume 2"	460
GOODMAN, LEO A. Correction to "Simultaneous confidence intervals for contrasts among multinomial populations"	821
GHOSH, MALAY AND SEN, PRANAB KUMAR. Correction to "Sequential rank tests for location"	821
NIGAM, A. K. Correction to "Block designs for mixture experiments" ..	1294-1295
SACKROWITZ, HAROLD B. AND COHEN, ARTHUR. Correction to "On estimating the common mean of two normal distributions"	1294
SEN, PRANAB KUMAR AND GHOSH, MALAY. Correction to "Sequential rank tests for location"	821

THE UNIVERSITY OF CHICAGO

DEPARTMENT OF THE HISTORY OF ARTS

ARTS AND SCIENCES DIVISION

OFFICE OF THE DEAN

CHICAGO, ILLINOIS

1950

RECEIVED
JAN 10 1950
OFFICE OF THE DEAN

THE UNIVERSITY OF CHICAGO

DEPARTMENT OF THE HISTORY OF ARTS

